

Content: 20230460

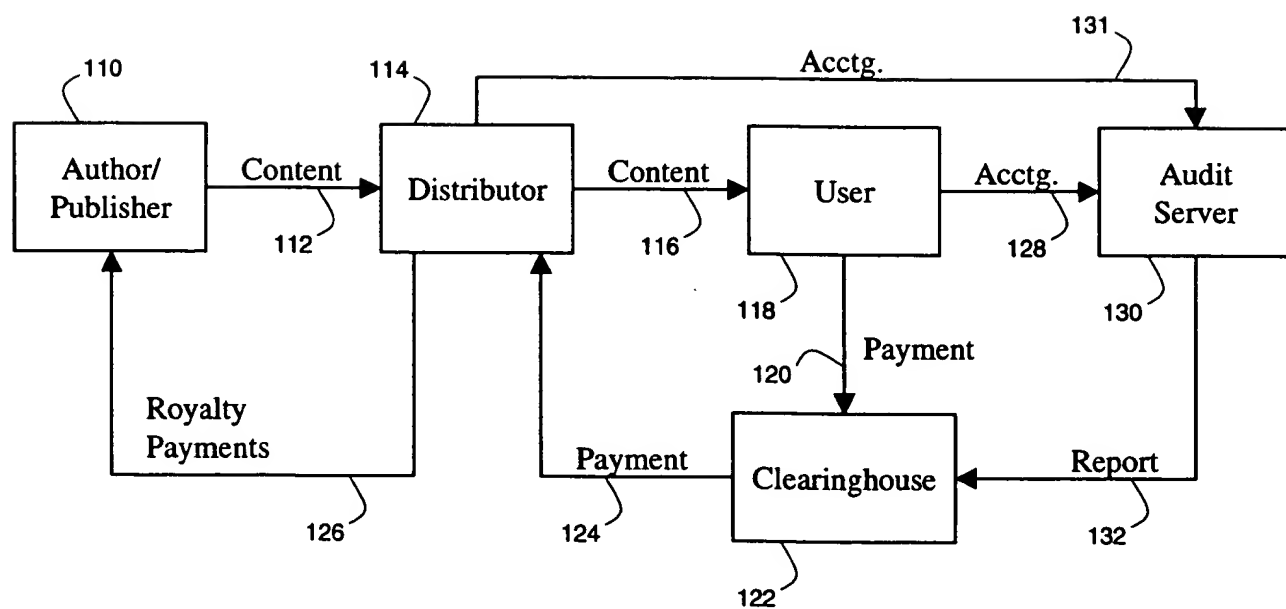


Fig. 1

Fig. 2

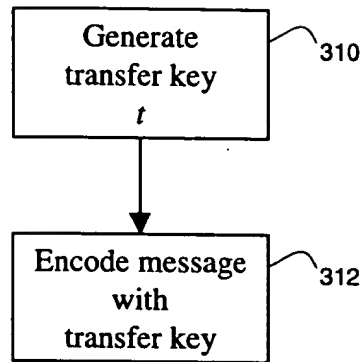


Fig. 3

1. *Chlorophyll a* (Chl *a*)
 2. *Chlorophyll b* (Chl *b*)
 3. *Chlorophyll c* (Chl *c*)
 4. *Chlorophyll d* (Chl *d*)
 5. *Chlorophyll e* (Chl *e*)
 6. *Chlorophyll f* (Chl *f*)
 7. *Chlorophyll g* (Chl *g*)
 8. *Chlorophyll h* (Chl *h*)
 9. *Chlorophyll i* (Chl *i*)
 10. *Chlorophyll j* (Chl *j*)
 11. *Chlorophyll k* (Chl *k*)
 12. *Chlorophyll l* (Chl *l*)
 13. *Chlorophyll m* (Chl *m*)
 14. *Chlorophyll n* (Chl *n*)
 15. *Chlorophyll o* (Chl *o*)
 16. *Chlorophyll p* (Chl *p*)
 17. *Chlorophyll q* (Chl *q*)
 18. *Chlorophyll r* (Chl *r*)
 19. *Chlorophyll s* (Chl *s*)
 20. *Chlorophyll t* (Chl *t*)
 21. *Chlorophyll u* (Chl *u*)
 22. *Chlorophyll v* (Chl *v*)
 23. *Chlorophyll w* (Chl *w*)
 24. *Chlorophyll x* (Chl *x*)
 25. *Chlorophyll y* (Chl *y*)
 26. *Chlorophyll z* (Chl *z*)
 27. *Chlorophyll aa* (Chl *aa*)
 28. *Chlorophyll ab* (Chl *ab*)
 29. *Chlorophyll ac* (Chl *ac*)
 30. *Chlorophyll ad* (Chl *ad*)
 31. *Chlorophyll ae* (Chl *ae*)
 32. *Chlorophyll af* (Chl *af*)
 33. *Chlorophyll ag* (Chl *ag*)
 34. *Chlorophyll ah* (Chl *ah*)
 35. *Chlorophyll ai* (Chl *ai*)
 36. *Chlorophyll aj* (Chl *aj*)
 37. *Chlorophyll ak* (Chl *ak*)
 38. *Chlorophyll al* (Chl *al*)
 39. *Chlorophyll am* (Chl *am*)
 40. *Chlorophyll an* (Chl *an*)
 41. *Chlorophyll ao* (Chl *ao*)
 42. *Chlorophyll ap* (Chl *ap*)
 43. *Chlorophyll aq* (Chl *aq*)
 44. *Chlorophyll ar* (Chl *ar*)
 45. *Chlorophyll as* (Chl *as*)
 46. *Chlorophyll at* (Chl *at*)
 47. *Chlorophyll au* (Chl *au*)
 48. *Chlorophyll av* (Chl *av*)
 49. *Chlorophyll aw* (Chl *aw*)
 50. *Chlorophyll ax* (Chl *ax*)
 51. *Chlorophyll ay* (Chl *ay*)
 52. *Chlorophyll az* (Chl *az*)
 53. *Chlorophyll aza* (Chl *aza*)
 54. *Chlorophyll abz* (Chl *abz*)
 55. *Chlorophyll aca* (Chl *aca*)
 56. *Chlorophyll acb* (Chl *acb*)
 57. *Chlorophyll acc* (Chl *acc*)
 58. *Chlorophyll acd* (Chl *acd*)
 59. *Chlorophyll ace* (Chl *ace*)
 60. *Chlorophyll acf* (Chl *acf*)
 61. *Chlorophyll acg* (Chl *acg*)
 62. *Chlorophyll ach* (Chl *ach*)
 63. *Chlorophyll aci* (Chl *aci*)
 64. *Chlorophyll acj* (Chl *acj*)
 65. *Chlorophyll ack* (Chl *ack*)
 66. *Chlorophyll acl* (Chl *acl*)
 67. *Chlorophyll acm* (Chl *acm*)
 68. *Chlorophyll acn* (Chl *acn*)
 69. *Chlorophyll aco* (Chl *aco*)
 70. *Chlorophyll acp* (Chl *acp*)
 71. *Chlorophyll acq* (Chl *acq*)
 72. *Chlorophyll acr* (Chl *acr*)
 73. *Chlorophyll acs* (Chl *acs*)
 74. *Chlorophyll act* (Chl *act*)
 75. *Chlorophyll acu* (Chl *acu*)
 76. *Chlorophyll acv* (Chl *acv*)
 77. *Chlorophyll acw* (Chl *acw*)
 78. *Chlorophyll acx* (Chl *acx*)
 79. *Chlorophyll acy* (Chl *acy*)
 80. *Chlorophyll acz* (Chl *acz*)
 81. *Chlorophyll azaa* (Chl *aza*)
 82. *Chlorophyll abz* (Chl *abz*)
 83. *Chlorophyll aca* (Chl *aca*)
 84. *Chlorophyll acb* (Chl *acb*)
 85. *Chlorophyll acc* (Chl *acc*)
 86. *Chlorophyll acd* (Chl *acd*)
 87. *Chlorophyll ace* (Chl *ace*)
 88. *Chlorophyll acf* (Chl *acf*)
 89. *Chlorophyll acg* (Chl *acg*)
 90. *Chlorophyll ach* (Chl *ach*)
 91. *Chlorophyll aci* (Chl *aci*)
 92. *Chlorophyll acj* (Chl *acj*)
 93. *Chlorophyll ack* (Chl *ack*)
 94. *Chlorophyll acl* (Chl *acl*)
 95. *Chlorophyll acm* (Chl *acm*)
 96. *Chlorophyll acn* (Chl *acn*)
 97. *Chlorophyll aco* (Chl *aco*)
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 100. *Chlorophyll acr* (Chl *acr*)
 101. *Chlorophyll acs* (Chl *acs*)
 102. *Chlorophyll act* (Chl *act*)
 103. *Chlorophyll acu* (Chl *acu*)
 104. *Chlorophyll acv* (Chl *acv*)
 105. *Chlorophyll acw* (Chl *acw*)
 106. *Chlorophyll acx* (Chl *acx*)
 107. *Chlorophyll acy* (Chl *acy*)
 108. *Chlorophyll acz* (Chl *acz*)
 109. *Chlorophyll azaa* (Chl *aza*)
 110. *Chlorophyll abz* (Chl *abz*)
 111. *Chlorophyll aca* (Chl *aca*)
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 114. *Chlorophyll acd* (Chl *acd*)
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 116. *Chlorophyll acf* (Chl *acf*)
 117. *Chlorophyll acg* (Chl *acg*)
 118. *Chlorophyll ach* (Chl *ach*)
 119. *Chlorophyll aci* (Chl *aci*)
 120. *Chlorophyll acj* (Chl *acj*)
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 122. *Chlorophyll acl* (Chl *acl*)
 123. *Chlorophyll acm* (Chl *acm*)
 124. *Chlorophyll acn* (Chl *acn*)
 125. *Chlorophyll aco* (Chl *aco*)
 126. *Chlorophyll acp* (Chl *acp*)
 127. *Chlorophyll acq* (Chl *acq*)
 128. *Chlorophyll acr* (Chl *acr*)
 129. *Chlorophyll acs* (Chl *acs*)
 130. *Chlorophyll act* (Chl *act*)
 131. *Chlorophyll acu* (Chl *acu*)
 132. *Chlorophyll acv* (Chl *acv*)
 133. *Chlorophyll acw* (Chl *acw*)
 134. *Chlor*

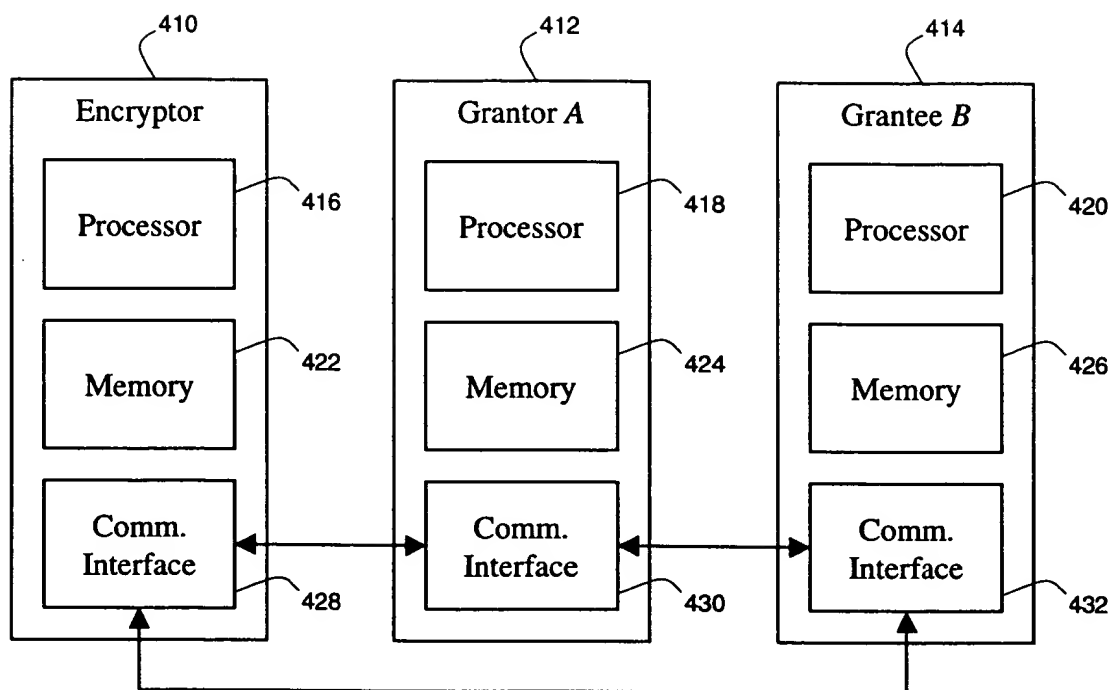


Fig. 4

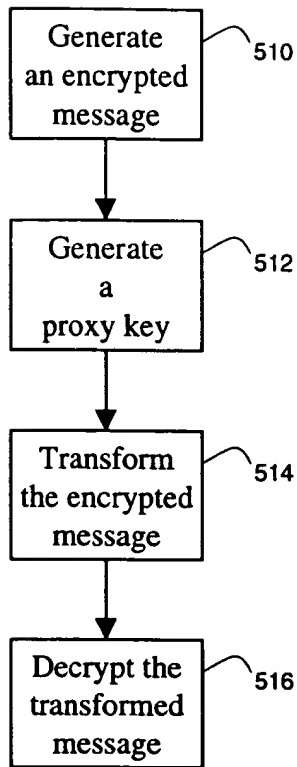


Fig. 5

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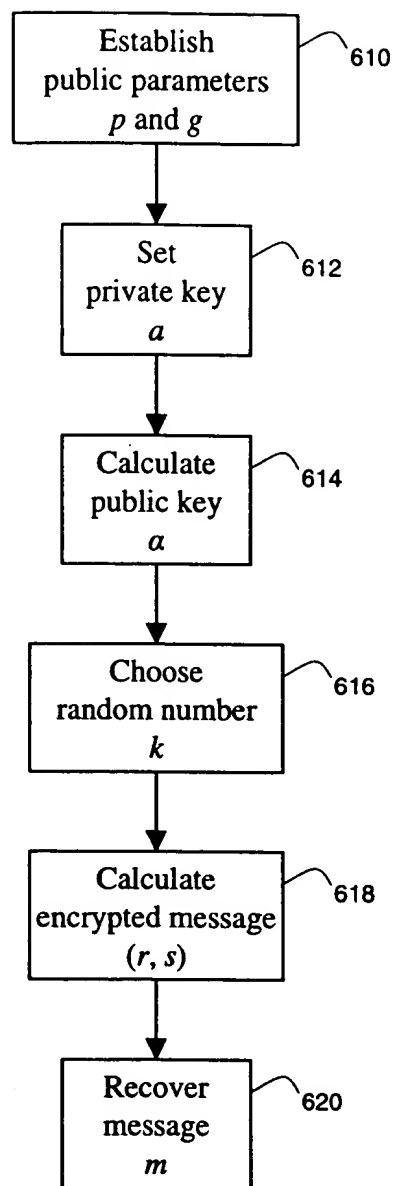


Fig. 6

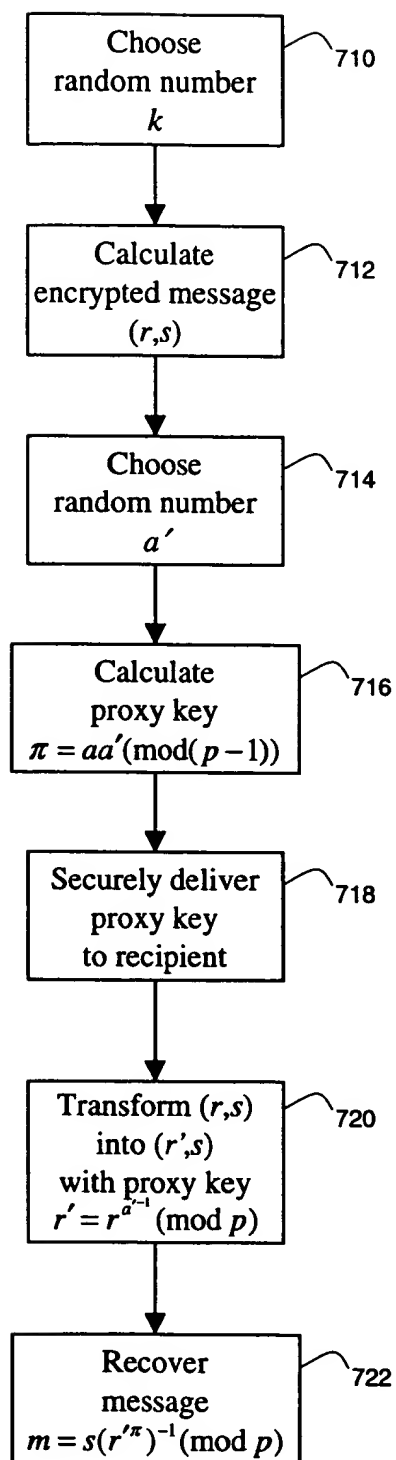


Fig. 7

Choose
random number
 k

Calculate encrypted message (r,s) 812

Obtain recipient's private key b 814

Calculate
proxy key
 $\pi = a^{-1}b \pmod{p-1}$

Transform (r,s)
into (r,s')
with proxy key
 $s' = s^{\pi} \pmod{p}$

```

    graph TD
      810[810] --> 820[820]
      820[820] --> 830[830]
      820 --> 840[840]
      820 --> 850[850]
      820 --> 860[860]
      820 --> 870[870]
      820 --> 880[880]
      820 --> 890[890]
      820 --> 900[900]
      820 --> 910[910]
      820 --> 920[920]
      820 --> 930[930]
      820 --> 940[940]
      820 --> 950[950]
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      820 --> 1020[1020]
      820 --> 1030[1030]
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      820 --> 1050[1050]
      820 --> 1060[1060]
      820 --> 1070[1070]
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      820 --> 1120[1120]
      820 --> 1130[1130]
      820 --> 1140[1140]
      820 --> 1150[1150]
      820 --> 1160[1160]
      820 --> 1170[1170]
      820 --> 1180[1180]
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      820 --> 1290[1290]
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```

Fig. 8

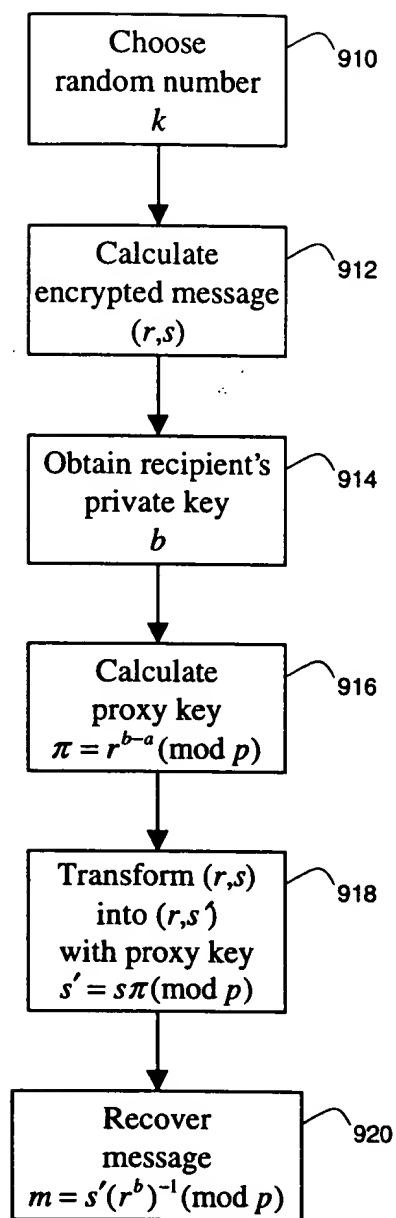


Fig. 9

```
graph TD; 1010[Choose random number k] --> 1012[Calculate encrypted message (r, s)]; 1012 --> 1014[Obtain recipient's private key b]; 1014 --> 1016[Calculate proxy key pi = (s^{a^{-1}})^{b-a} (mod p)]; 1016 --> 1018[Transform (r, s) into (r, s') with proxy key s' = s pi (mod p)]; 1018 --> 1020[Recover message m = r (s'^{b^{-1}})^{-1} (mod p)];
```

Fig. 10

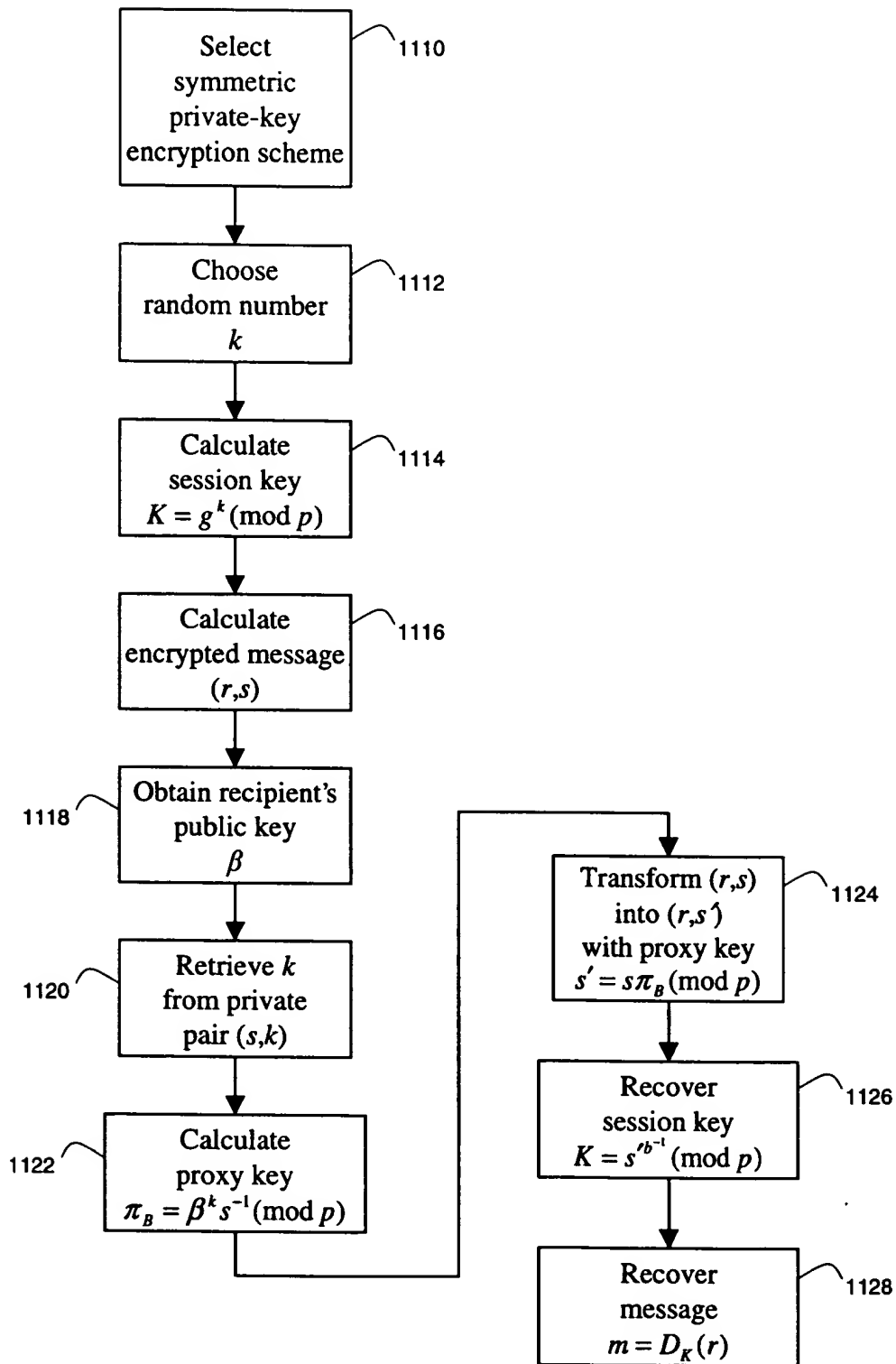


Fig. 11

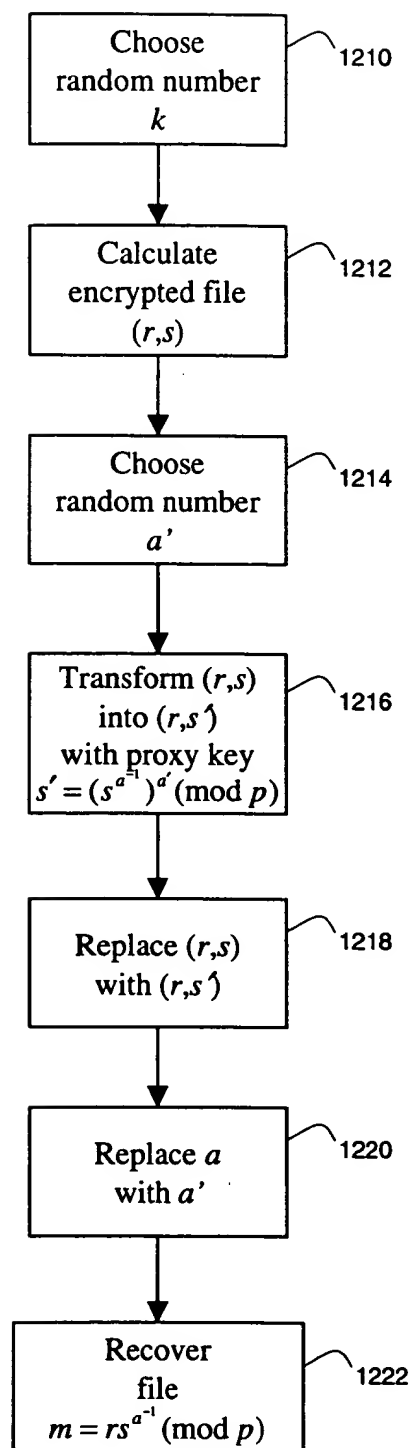


Fig. 12

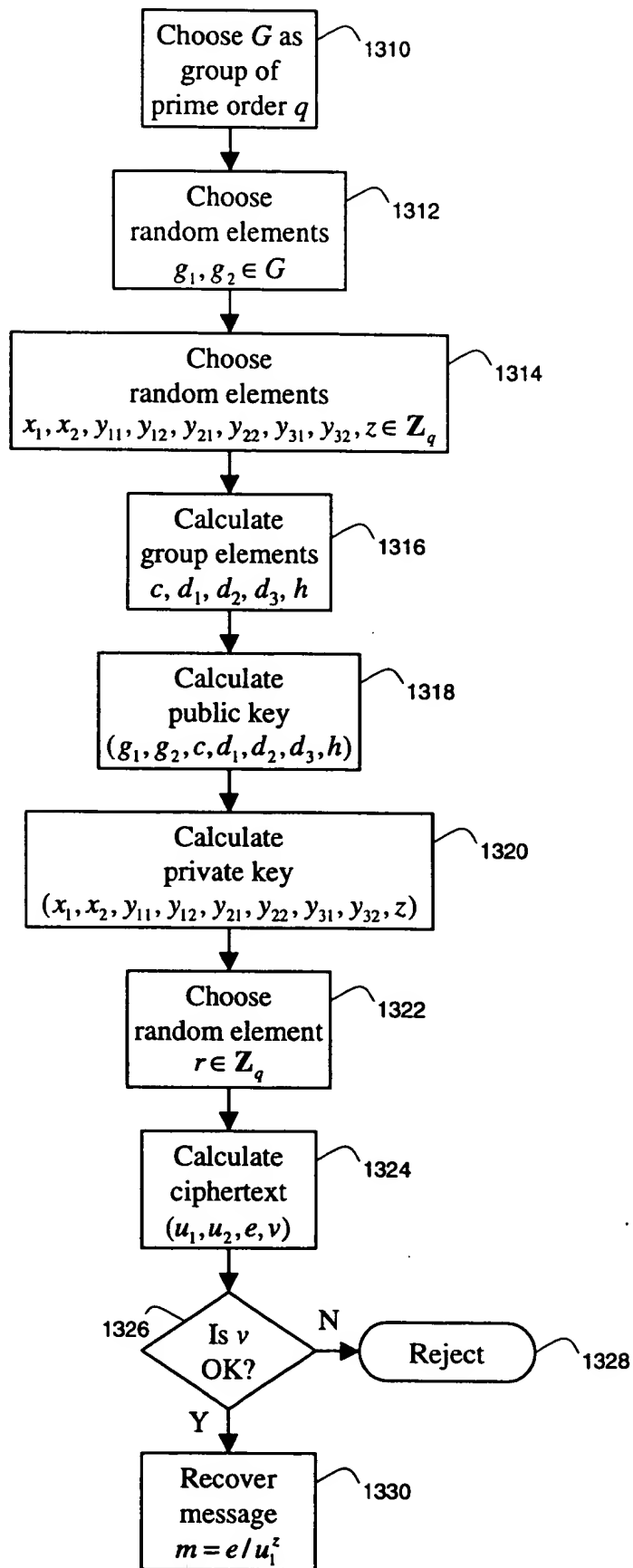


Fig. 13

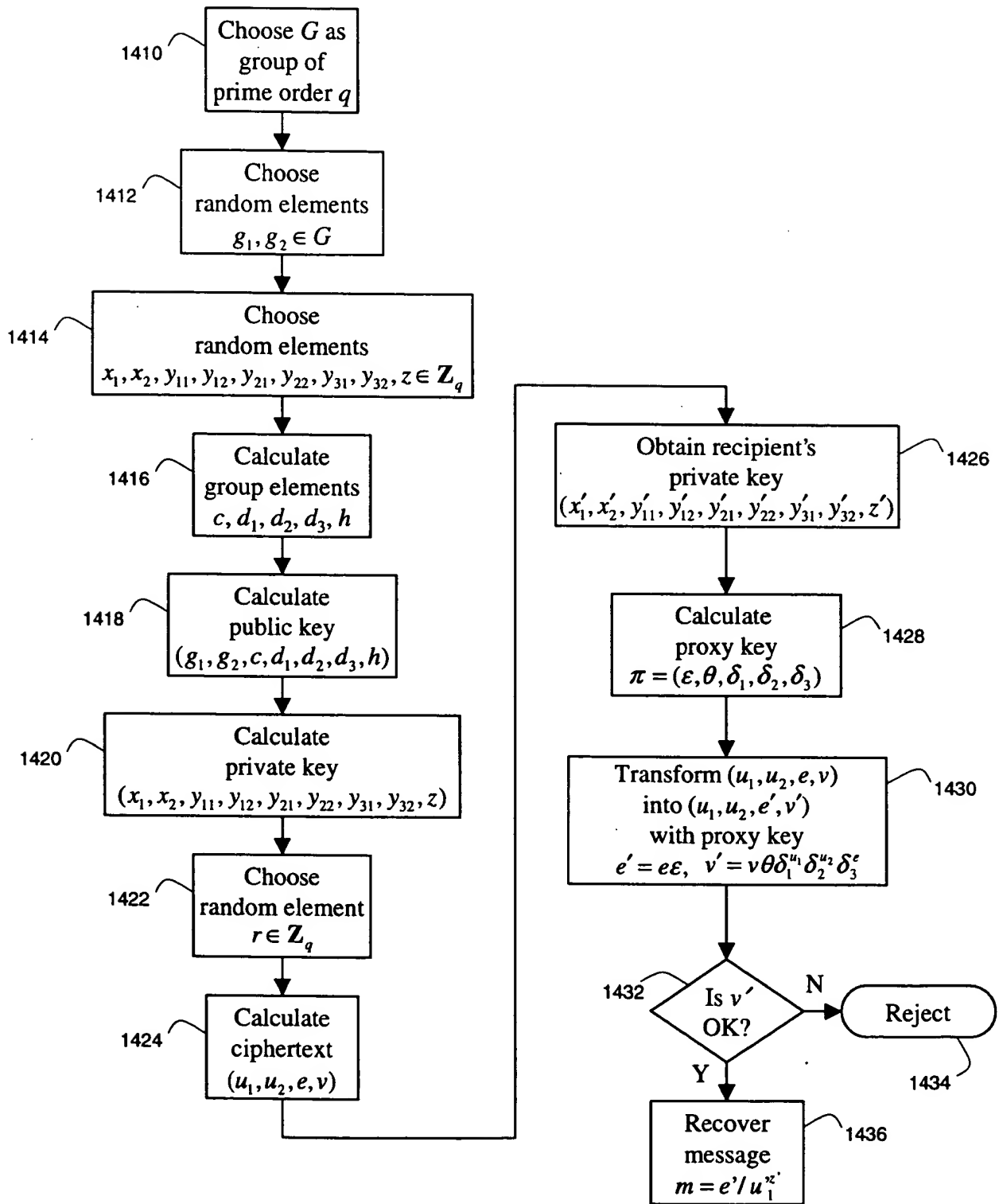


Fig. 14